Reactants (left) "conversion"

→ **Concept of Relative Atomic mass** Avogadro's number (N_A)

Mole 1 mole of any substance contains $6.02 \times 10^{+23}$ particle

- atoms → 1 mole = gram atom
- ions (gram ion)
- molecules (gram molecule)
- ionic compound (formula unit) (gram F.U)

(Expression of atomic mass, ionic mass, molecular mass or formula mass expressed in terms of grams → 1 mole)

e.g

→ H - 1 amu = one atom of H

H - (1g = 1 mole) = 6.02×10^{23} atom

→ Na^+ - 23 amu = 1 ion of Na

Na^+ - 23g = 1 mole = 6.02×10^{23} ions

→ H_2O - 18 amu = 18g = 1 mole of water = 6.02×10^{23} molecules

Q) 18 g molecules of water is equal to - 18 moles of water (1g = 1 mole, 18g = 18 moles)

2+16+ 16/54 32/54

Q) 49 g of H_2SO_4 number of moles of oxygen atoms are = 2 moles

O_4 = 4 atoms of O

= 4g = 4 moles

no of moles = mass of the substance / molar mass

$n = \frac{mass}{molar\ mass}$

$= \frac{49}{48}$ ≈ $\frac{1}{2}$ moles of H_2SO_4 → 1 mole

1 mole

½ mole

49/g = Mass

No of particles = moles × N_A

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Calculation Mole (n)

Day: → n = mass of substance / molar mass Date: / /

applicable on gases → $n = \frac{V}{V_m}$ (V_m molar volume)

→ n = no of particles (N) / N_A

1 mole of any gas → STP → 22.414 dm^3

Standard T = 0°C or 273 k°

P = 1 atm.

1 mole of H_2 gas = 22.414 dm^3

$\frac{22.414}{1000}$ dm^3 → 22414 m^3

→ WOF has max number of molecules.

•) 1.7g of NH_3 ⊙ 2g of H_2 •) 4.6g of NO_2 •) 3.2g of SO_4

$n = \frac{m}{m} = \frac{1.7}{17g} = 0.1$ mole

$n = \frac{m}{m} = \frac{2}{2} = 1$ mole

$n = \frac{4.6}{46_S} = 0.1$ mole

$n = \frac{m}{m} \frac{3.2}{96}$

→ How many moles of CO_2 will occupy 5.6 dm^3 volume at STP.

12 + 32 = 44g

1 mole = 22.414 dm^3

$n = \frac{V}{V_m} = \frac{5.6 dm^3}{22.414 dm^3} = \frac{1}{4}$

Ans) • 1/4 moles

→ Volume occupied by 9.9g of CO_2 at STP.

→ **Empirical formula**

Molecular formula = n × (E.F) = 6 × CH = C_6H_6

M.F of benzene = C_6H_6 (actual number of atoms in a molecule)

E.F 6(CH) V.V (simplest whole number ratio b/w atoms)

→ 12 + 2 + 16 = 30

E.F CH_2O

molar mass = 60 $g mol^{-1}$

$n = \frac{60}{30} = 2 g mol^{-1}$

$n = \frac{\text{Molecular mass}}{(\text{formula mass})}$ → M.F = n × (CH_2O)

obtained from E.F

2 × (CH_2O)

= $C_2H_4O_2$

CH_3COOH → Acetic acid

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E.F: CH_2 = 12+2 = 14g

Day: Molecular mass = 2800g/mol

$n = \frac{2800}{14} = 2000$

M.F = $2000 \times (CH_2)$

→ X → 25% with 5 amu

Y → 75% with 10 amu

① X : Y

25 : 75 is

5 : 15

② 5 : 7.5 → 5 : 1.5 → 1 : 1.5

1×2 : 1.5×2

2 : 3

$X_2 Y_3$

Date:

Steps
1. To find % age composition
2. determination of no of grams atoms/mole
3. Mole ratio
4. multiply with suitable digit to get E.F

% percentage composition = $\frac{\text{mass of element in compound}}{\text{molar mass of compound}} \times 100$

% of O_2 in H_2O = $\frac{16}{18} \times 100$

$\frac{15}{18} \times 100$ $\quad \frac{16}{18} \times 100 = 88.$

Stochiometry

- Quantitative relation b/w reactants & products
- based on balanced chemical equation

R → P

m → m
m → V
m → mol

moles of reactant predicts of product

In gases
vol → V
vol → m
vol → mol.

Assumptions

All R → P

No side reaction

Obey → law of conservation of mass
→ law of definite proportion

Limiting Reactant

- controls amount of product
- less amount of product
- controls reaction
- reaction in less amount

→ reaction should be
- balanced
- irreversible

L.R = ?

Q) $2H_2 + O_2 \rightarrow 2H_2O$

8g 8g

no of moles of H_2 = $\frac{8}{2}$ = 4 moles

no of moles of O_2 = $\frac{8}{32}$ = $\frac{1}{4}$

16

H_2 $\frac{4}{2} = 2$

$O = \frac{0.25}{1} = 0.25$

L.R = $\frac{\text{moles}}{\text{coefficient}}$

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(L of R: $\frac{\text{given mass}}{\text{molar mass}} \times$ coefficient)

Day: Date: / /

Q = How many moles of non-limiting reactant will react

(always on left) Limiting reactant : non-limiting (to find) always on right

$O_2 : H_2$

no of moles → 1 : 2 in (balanced chem eq)

0.25 : 2 × 0.25

= 0.5 moles

Percentage ← Yield → Theoretical yield (Balanced eq)

→ Actual yield → (experimental)

$\left(\frac{A.Y}{T.Y} \times 100\right)$

Q) $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

from 50 g ⟶ 21 g find: % yield = ?

molar mass of $CaCO_3$ → 40 + 12 + 48 = 100 g/mol

" CaO = 40 + 16 = 56 g/mol

$CaCO_3 : CaO$

100 : 56 → 1 g = $\frac{56}{100}$

50 : 21

for 1 g → 1 g = $\frac{21}{50}$ A : I

$50 = \frac{56 \times 50}{100}$

50 g = $\frac{21 \times 50}{50}$ = 28 g (Theoretical yield)

% = $\frac{A.Y}{T.Y} = \frac{21}{28} \times 100$

$= \frac{20}{28}$ 75%

Q) volume occupied by 9.9 g CO_2 at STP

12 + 32

44

4.4

R M → V = ? P

$n = \frac{m}{M} = \frac{V}{Vm}$

given ← m . V = N

molar ← M Vm NA

$\frac{mVm}{M} = V$

$\frac{9.9 \times (22.414)}{44}$

9.9 g (22.414)

44 g

$\frac{9.9}{44} \times 22.414$

$V = 2.24 dm^3$

$O_2 \rightarrow 11.2 dm^3$

N = ?

$\frac{V}{Vm} = \frac{N}{Na} \rightarrow \frac{V \times NA}{Vm} = \frac{11.2 \times 6.02 \times 10^{23}}{22.414}$

$= 3.02 \times 10^{23}$

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No of atoms = (moles) $n \times N_A \times$ atomicity (no of atoms in a molecule)

Day: Date: / /

Atoms in 2 moles of H_2 = $2 \times 6.02 \times 10^{23} \times 2$

$= 2.4 \times 10^{24}$ atom.

if m → No of atoms $= \frac{\text{given mass (m)}}{\text{molar mass (M)}} \times N_A \times$ atomicity → if mass is given instead of moles

$= \frac{V}{V_m} \times N_A \times$ atomicity

Q) (m) mass = 49 g

m of H_2SO_4 = 2 + 32 + 64 = 98 g

moles (n) = $\frac{1}{98} \times 6.022 \times 10^{23}$

$= \frac{1}{2} N_A = 3.5 N_A$

Q) 7g → N_2, 8g → O_2, 1g → H_2

$n = \frac{7}{28} = 0.25$ $n = \frac{8}{32} = 1$ $n = \frac{1}{2} = 0.5$ moles

0.25

n of $N_2 + O_2 + H_2$ = 1 mole @ STP = 22.4 L

Past paper MCQ's

→ The number of moles of CO_2 which contain 8.00 gm of O_2 is

In 1 mole of CO_2 = O_2 is 32g

$\frac{1}{32} = \frac{1}{32}$ g

$\frac{1}{4} = 0.25$ $\frac{8}{32} \times 1 = 8$ g

0.25 moles of CO_2

O_2 = 0.5 moles

CO_2 : O_2

1 : 0.5 moles

$\frac{1}{2} \times 0.5 = 0.5$ mole

2 moles of O_2

0.25 moles

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a) $C_6H_{12}O_6$ → mass = ?

Day: Date: / /

→ no of atoms of C = 3.6×10^{24} atoms

6 atoms of C = 1 molecule of glucose

1 = $\frac{1}{6}$

$3.6 \times 10^{24} = \frac{1}{6} \times 3.6 \times 10^{24}$

$6\overline{)36}$ (6, 36)

$= 2.6 \times 10^{24} \cdot 0.6 \times 10^{24} \cdot 6 \times 10^{23} = N_A$

1 mole of $C_6H_{12}O_6$ = 180 g

→ C atoms = ? in 2 moles of C

no of atoms = moles × 6.022×10^{23}

= $2 \times 6.022 \times 10^{23}$ atom

1 N_A atom = 23 amu

1 $N_A^{H_2O}$ = 18 amu

→ 1 amu of H = 1 H atom

1 g of H = 6.022×10^{23} atom

23 g = 1 mole = 6.022×10^{23} atoms (N_C)

1 gram atom = 1 mole

→ Charge on 1 mole of proton

1 mole = 6.023×10^{23}

1 proton → 1.6022×10^{-19} = 1 mole 6.02×10^{23}

= $6.02 \times 10^{23} \times 1.6022 \times 10^{-19}$

= 9.699×10^{4}

→ Mass & charge on 1 mole of $\bar{e}$

charge on 1 mole of $\bar{e}$ = $1.66 \times 10^{19} \times 6.022 \times 10^{23}$

= 9.99×10^{4} C

$n = \frac{m}{m} \times N_A$ → Mass of $1\bar{e}$ = 9.1×10^{-31} kg → g

= $9.1 \times 10^{-31} \times 1000$ g

= 9.1×10^{-28} kg

→ No of $\bar{e}$'s in 1g = $\frac{1}{9.1 \times 10^{-28}}$ = 1.097×10^{27} $\bar{e}$

→ Mass on 1 mole of $\bar{e}$ = $6.02 \times 10^{23} \times 9.1 \times 10^{-28}$

= 5.48×10^{-4} g.

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